



Department of Transportation
Federal Aviation Administration
Aircraft Certification Service
Washington, D.C.

TSO-C179b

Effective
Date: 3/23/18

Technical Standard Order

Subject: *Rechargeable Lithium Batteries and Battery Systems.*

1. **PURPOSE.** This technical standard order (TSO) is for manufacturers applying for a TSO authorization (TSOA) or TSO letter of design approval (LODA). In it, we (the Federal Aviation Administration, (FAA)) tell you what minimum performance standards (MPS) your rechargeable lithium cells, lithium batteries and battery systems must meet for approval and identification with the applicable TSO marking.

2. **APPLICABILITY.** This TSO affects new applications submitted after its effective date.

a. TSO-C179a will also remain effective until September 23, 2018. After this date, we will no longer accept applications for TSO-C179a.

b. Rechargeable lithium cells, lithium batteries and battery systems approved under a previous TSOA may still be manufactured under the provisions of its original approval.

3. **REQUIREMENTS.** New models of rechargeable lithium cells and lithium batteries and battery systems identified and manufactured on or after the effective date of this TSO must meet the MPS qualification and documentation requirements in section 1 and section 2 of RTCA document, DO-311A, *Minimum Operational Performance Standards for Rechargeable Lithium Batteries and Battery Systems*, dated December 19, 2017. The FAA did not acknowledge Appendix C of DO-311A for this TSO. Section 1.4.1 and section 1.4.2 of RTCA/DO-311A lists the energy categories and venting categories. Testing will be based on these categories and must be identified as such in paragraph 4 of this TSO.

a. **Functionality.** This TSO's standards apply to equipment with rechargeable lithium cells, lithium batteries and battery systems intended to provide power for aircraft equipment, including emergency systems.

b. **Failure Condition Classifications.** There is no standard minimum failure condition classification for this TSO. The failure condition classification appropriate for the equipment will depend on the intended use of the equipment in a specific aircraft. Document the loss of function and malfunction failure condition classification for which the equipment is designed.

c. **Functional Qualification.** Demonstrate the required functional performance under the test conditions specified in section 2.2.1 of RTCA/DO-311A, *Minimum Operational Performance Standards for Rechargeable Lithium Batteries and Battery Systems*, dated 19 December 2017.

Note: The use of RTCA/DO160D (with Changes 1 and 2 only, without Change 3 incorporated) or earlier versions is generally not considered appropriate and will require substantiation via deviation process as discussed in paragraph 3g of this TSO.

d. **Environmental Qualification.** Demonstrate the required performance under the test conditions specified in section 2.3 of RTCA/DO-311A, *Minimum Operational Performance Standards for Rechargeable Lithium Batteries and Battery Systems*, 19 December 2017, using standard environmental conditions and test procedures appropriate for airborne equipment.

e. **Software Qualification.** If the article includes software, develop the software according to RTCA, Inc. document RTCA/DO-178C, *Software Considerations in Airborne Systems and Equipment Certification*, dated December 13, 2011, including referenced supplements as applicable, to at least the software level consistent with the failure condition classification defined in paragraph 3.b of this TSO. You may also develop the software according to RTCA, Inc. document RTCA/DO-178B, dated December 1, 1992 if you follow the guidance in AC 20-115C (latest revision), *Airborne Software Assurance*, dated July 19, 2013.

f. **Electronic Hardware Qualification.** If the article includes complex custom airborne electronic hardware, develop the component according to RTCA, Inc. Document RTCA/DO-254, *Design Assurance Guidance for Airborne Electronic Hardware*, to at least the design assurance level consistent with the failure condition classification defined in paragraph 3.b of this TSO. AC 20-152 references RTCA/DO-254.

g. **Deviations.** We have provisions for using alternate or equivalent means of compliance with the criteria in the MPS of this TSO. If you invoke these provisions, you must show that your equipment maintains an equivalent level of safety. Apply for a deviation pursuant to 14 CFR § 21.618.

4. **MARKING.**

a. Mark each battery and battery system (article) permanently and legibly with all the information in 14 CFR § 45.15(b) and section 2.1.3 of RTCA/DO-311A. The marking must include the serial number.

b. Mark the lithium battery and battery system (article) based on the following table: Label the TSO as **TSO-C179b-CLASS A-XY** or **TSO C179b-CLASS B-XY** as shown below (where –X stands for energy category and Y stands for venting category as listed in the table below):

TSO-C179b CLASS A – During the RTCA/DO-311A section, 2.4.5.5 Battery Thermal Runaway Containment Test All cells within the battery must enter Thermal Runaway.

TSO-C179b CLASS B – During the RTCA/DO-311A section 2.4.5.5 Battery Thermal Runaway Containment Test Not all cells within the battery enter Thermal Runaway.

Energy Category (X)	Venting Category (Y)
1	A
1	B
1	C
2	A
2	B
2	C
3	A
3	B
3	C
4	A
4	B
4	C

(For example: TSO-C179b CLASS B- 1A would be a rechargeable lithium battery and battery system that is of energy category 1 and a venting category of A and not all the cells entered thermal runaway during RTCA/DO-311A section 2.4.5.5 testing.)

c. Also, mark the following permanently and legibly, with at least the subassembly part number of the approved TSO configuration:

- (1) Each component that is easily removable (without hand tools); and,
- (2) Each subassembly of the article that you determined may be interchangeable.

d. If the article includes software and/or airborne electronic hardware, then the article part numbering scheme must identify the software and airborne electronic hardware configuration. The part numbering scheme can use separate, unique part numbers for software, hardware, and airborne electronic hardware.

e. You may use electronic part marking to identify software or airborne electronic hardware components by embedding the identification within the hardware component itself (using software) rather than marking it on the equipment nameplate. If electronic marking is used, it must be readily accessible without the use of special tools or equipment.

5. APPLICATION DATA REQUIREMENTS. You must give the FAA Aircraft Certification Office (ACO) manager responsible for your facility a statement of conformance, as specified in 14 CFR § 21.603(a)(1) and one copy each of the following technical data to support your design and production approval. LODA applicants must submit the same data (excluding paragraph 5.g) through their civil aviation authority.

- a. A Manual(s) containing the following:

(1) Operating instructions and article limitations sufficient to describe the equipment's operational capability.

(2) Detailed description of any deviations.

(3) A summary of test results including pass/fail criteria and the required reportable information according to paragraph 3 of this TSO.

(4) Installation procedures and limitations sufficient to ensure that the rechargeable lithium batteries and battery systems when installed according to the installation or operational procedures, still meet this TSO's requirements. Limitations must identify any unique aspects of the installation. The limitations must include a note with the following statement:

“This article meets the minimum requirements of technical standard order (TSO) C179b. Installation of this article requires separate approval.”

(5) For each unique configuration of software and airborne electronic hardware, reference the following:

(a) Software part number, including revision and design assurance level,

(b) Airborne electronic hardware part number including revision and design assurance level, and

(c) Functional description.

(6) A summary of the test conditions used for environmental qualifications for each component of the article. For example, a form as described in RTCA/DO-160G, *Environmental Conditions and Test Procedures for Airborne Equipment*, Appendix A.

(7) Schematic drawings, wiring diagrams, and any other documentation necessary for installation of the rechargeable lithium batteries and battery systems.

(8) By-part-number list of replaceable components that makes up the rechargeable lithium battery and battery system. Include vendor part number cross-references, when applicable.

b. Instructions covering periodic maintenance, calibration, and repair, to ensure that the rechargeable lithium batteries and battery systems continue to meet the TSO approved design. Include recommended inspection intervals and service life as appropriate.

c. If the article includes software: a plan for software aspects of certification (PSAC), software configuration index, and software accomplishment summary.

d. If the article includes simple or complex custom airborne electronic hardware: a plan for hardware aspects of certification (PHAC), hardware verification plan, top-level drawing, and hardware accomplishment summary (or similar document, as applicable).

e. A drawing depicting how the article will be marked with the information required by paragraph 4 of this TSO.

f. The quality manual required by 14 CFR 21.608, including functional test specifications. The quality system must ensure that you will detect any change to the approved design that could adversely affect compliance with the TSO MPS and reject the article accordingly. Applicants who currently hold TSOAs must submit revisions to the existing quality manual as necessary (not required for LODA applicants).

g. A description of your organization as required by 14 CFR 21.605.

h. Material and process specifications list.

i. A list of all drawings and processes (including revision level) that define the article's design.

j. Manufacturer's TSO qualification report showing results of testing accomplished according to paragraph 3.c of this TSO

k. One copy of the test results including methods, data and test reports from testing in accordance with paragraph 3 of this TSO.

6. MANUFACTURER DATA REQUIREMENTS. Besides the data given directly to the responsible ACO, have the following technical data available for review by the responsible ACO:

Note: The following data for a LODA applicant may be made available for review through its CAA. Refer to the applicable bilateral agreement for specific details regarding access to this data.

a. Functional qualification specifications for qualifying each production article to ensure compliance with this TSO.

b. Article calibration procedures.

c. Schematic drawings.

d. Wiring diagrams.

e. Material and process specifications.

f. The results of the environmental qualification tests conducted according to paragraph 3.d of this TSO.

g. If the article includes software, the appropriate documentation defined in RTCA/DO-178B or RTCA/DO-178C specified in paragraph 3 e of this TSO including all data supporting the applicable objectives in RTCA/DO-178B *Annex A, Process Objectives and Outputs by Software Level*.

h. If the article includes complex custom airborne electronic hardware, the appropriate hardware life cycle data in combination with design assurance level, as defined in RTCA/DO-254, Appendix A, Table A-1. For simple custom airborne electronic hardware, the following data are required: test cases or procedures, test results, test coverage analysis, tool assessment and qualification data, and configuration management records, including problem reports.

7. FURNISHED DATA REQUIREMENTS.

a. When furnishing one or more articles manufactured under this TSO to one entity (such as an installer, operator or repair station), provide one copy or online access to the data in paragraphs 5.a and 5.b of this TSO. Add any other data needed for the proper installation, certification, use, or for continued compliance with the TSO, of the rechargeable lithium batteries and battery systems.

b. If the article contains software, include one copy of the open problem reports (OPR) summary within functional inputs.

8. HOW TO GET REFERENCED DOCUMENTS.

a. Order RTCA documents from RTCA, Inc., 1150 18th Street NW., Suite 910, Washington, DC 20036. Telephone: (202) 833-9339; fax: (202) 833-9434. You can also order copies online at www.rtca.org.

b. Order copies of parts 21 and 45 {add additional applicable parts} from the Superintendent of Documents, Government Printing Office, PO Box 979050, St. Louis, MO 63197-9000. Telephone: (202) 512-1800, fax: (202) 512-2104. You can also order copies online at www.gpo.gov.

c. You can find a current list of TSOs and advisory circulars at <http://rgl.faa.gov/>. You will also find the TSO Index of Articles at the same site.



Louis R. Volchansky
Manager, Systems and Equipment Standards Branch
Aircraft Certification Service